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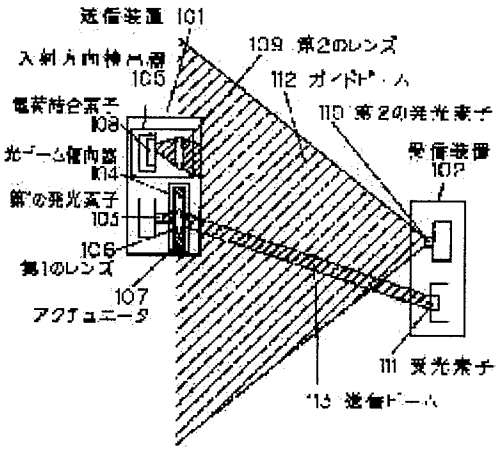
(54) SPATIAL LIGHT TRANSMITTER AND LIGHT BEAM DEFLECTOR

(57)Abstract:

PURPOSE: To provide the spatial light transmitter in which high rate transmission is attained with small radiation power by controlling strictly the radiation direction of a transmission beam with a small spread angle.

CONSTITUTION: The system is provided with a transmitter 101 and a receiver 102. A 2nd light emitting element 110 of the receiver 102 emits a divergent guide beam 112 and an incident direction detector 105 of the transmitter 101 receives the beam to identify the direction of the receiver 102 when viewing from the transmitter 101. A transmission beam 113 emitted from a 1st light emitting element 106 is collimated by a light beam deflector 104 and deflected. The transmission beam 113 is emitted in the direction of the receiver 102 by controlling the deflection direction with an output signal from the incident direction detector 105. The transmission beam 113 is received by the light receiving element 111 of the receiver 109. The guide beam 112 is modulated by a signal whose rate is lower than the transmission beam 113.



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CLAIMS

[Claim(s)]
[Claim 1] The sending set containing the direction detector of incidence which judges the direction of incidence of the 1st light emitting device which carries out outgoing radiation of the transmitting beam, the light beam deflecting system which deflects said transmitting beam, and a guide beam, It has a receiving set containing the photo detector which receives the 2nd light emitting device which carries out outgoing radiation of said guide beam, and said transmitting beam. It is the space optical transmission device which said transmitting beam has an angle of divergence narrower than said guide beam, and is characterized by modulating said guide beam by the low-speed signal rather than said transmitting beam.
[Claim 2] The space optical transmission device according to claim 1 characterized by for the 1st light emitting device being a surface emission-type laser, and the 2nd light emitting device being light emitting diode.
[Claim 3] The space optical transmission device according to claim 1 characterized by light beam deflecting system consisting of an optical element and an actuator.
[Claim 4] The space optical transmission device according to claim 1 characterized by the direction detector of incidence consisting of a lens and a charge-coupled device.
[Claim 5] The space optical transmission device according to claim 1 characterized by the direction detector of incidence consisting of an optical element driven with an actuator, and a photo detector.
[Claim 6] A support substrate, the light emitting device carried on said support substrate, and the photo detector which adjoined said light emitting device and was carried on said support substrate, The lens array which contains in said support substrate the 1st and 2nd lenses by which opposite arrangement was carried out, It is the space optical transmission device characterized by having the actuator which drives said lens array, for the outgoing radiation beam from said light emitting device passing said 1st lens, and the incident beam to said photo detector passing said 2nd lens.
[Claim 7] the part on a semi-conductor substrate and said semi-conductor substrate -- the part except the surface emission-type laser formed in the field with the lower reflector by which the laminating was carried out one by one, the lower cladding layer, the barrier layer, the up cladding layer, and the up reflector, and said surface emission-type laser on said semi-conductor substrate having been formed -- the space optical transmission device characterized by having the light emitting diode formed in the field of said lower reflector by which the laminating was carried out one by one, said lower cladding layer, said barrier layer, and said up cladding layer.
[Claim 8] the part on the 1 principal plane of a semi-conductor substrate and said semi-conductor substrate -- light beam deflecting system including the support rack which connects the optical element of the suspension condition formed in the boundary region except an opening field in said opening field with the 1st and 2nd thin films by which sequential deposition was carried out, and said 2nd thin film, and said the 2nd thin film and said optical element on said boundary region, and the means to which the variation rate of said support rack is carried out with an electrical signal.
[Claim 9] Light beam deflecting system according to claim 8 characterized by an optical element being a

reflecting mirror.
[Claim 10] Light beam deflecting system according to claim 8 characterized by an optical element being a hologram lens.
[Claim 11] Light beam deflecting system according to claim 8 characterized by forming the light emitting device on the 2nd [of a semi-conductor substrate] principal plane.
[Claim 12] Light beam deflecting system according to claim 11 characterized by a light emitting device being a surface emission-type laser.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the light beam deflecting system which deflects the direction of the space optical transmission device and outgoing radiation light beam which perform a signal transmission by the light beam which spreads free space in the specific direction.
[0002]
[Description of the Prior Art] There is infrared remote control used more widely than before as a space optical transmission device which performs a signal transmission by the light beam which spreads free space. Although it is thought that explanation is not required especially about this infrared remote control, it controls turning a remote device on and off etc. by the sending set carrying the light emitting diode which carries out outgoing radiation of the infrared light beam, and the so-called remote control. Since this infrared remote control only transmits an easy control signal, the modulation rate of a signal is very slow. As an example which performs a high-speed signal transmission from this, wireless headphone and the optical transmission device between video television interspace are commercialized in recent years. By wireless headphone, in the sound signal and the optical transmission device between video television interspace, the video signal is transmitted and the modulation rate of a signal is expanded to several MHz from dozens of kHz.
[0003] With the space optical transmission device described above, outgoing radiation of the transmitting beam is carried out by the comparatively large radiation angle. Although this is for making directional control of a transmitting beam easy consequently, the ratio of the optical power received with the receiving set to the optical power by which outgoing radiation is carried out from a sending set becomes very small. Generally, when a modulation rate is small, it can restore also to small light-receiving power, but light-receiving power required for a recovery becomes large, so that a modulation rate becomes large. That is, in order to perform a high-speed signal transmission with a space optical transmission device, high light-receiving power is needed for the top where the ratio of the light-receiving power to outgoing radiation power is small, and outgoing radiation power from a sending set must be enlarged very much. This brings about the result of power consumption increase of the whole sending set.
[0004] Next, the Prior art about the light beam deflecting system which is this application the 2nd invention is described. It is divided roughly into the thing of carrying out the variation rate of the optical elements, such as a polygon mirror, mechanically, and the thing of changing the refractive index of optical elements, such as a diffraction grating, by the electro-optical effect etc., as an approach of deflecting a light beam. Generally, although it has the advantage that the loss of the optical power by beam deflection of the former is small, and a big deflecting angle is obtained, the whole equipment becomes large and there is a fault that a working speed is slow. On the other hand, the latter is still in a development stage, although a miniaturization and improvement in the speed are expected, and about effectiveness and a deflecting angle, its room of an improvement is large. As a latter example, there are some which are shown in drawing 5 the "property improvement of field outgoing radiation mold optical

deflection component" 36th Japan Society of Applied Physics relation union [besides Tone] lecture meeting (April 1 - Heisei first year 4, Chiba University), the collection 3rd separate volume of lecture drafts, and given in 926 page (lecture number 2 p-PB -15).
[0005] The laminating of a buffer layer 502, the 1st cladding layer 503, a barrier layer 504, the barrier layer 505, the guide layer 506, the 2nd cladding layer 507, and the contact layer 508 is carried out on the GaAs substrate 501, and the diffraction grating 509 is formed on the guide layer 506. The diffraction grating 509 is the secondary [about] diffraction grating to the incident light beam 510, and the diffracted outgoing radiation light beam 511 is outputted up. Here, if current impregnation is carried out, the refractive index will change and the effectual pitch of a diffraction grating will change to a barrier layer 504. Consequently, the direction of outgoing radiation of the outgoing radiation light beam 511 will change. About 0.5-degree deviation is checked as an experimental result.
[0006]
[Problem(s) to be Solved by the Invention] As the above-mentioned Prior art described, the modulation rate of a current space optical transmission device is about several MHz. However, considering application of connecting a peripheral device with a pocket mold computer by the space light interconnection from which development will be expected from now on, the transmission rate or parallel transmission of hundreds of or more Mbpses is needed. If it is going to perform a high-speed signal transmission, outgoing radiation power from a sending set must be enlarged, and the power consumption of the whole sending set will increase. Although what is necessary is just to enlarge the ratio of the light-receiving power to outgoing radiation power in order to solve this problem, when the radiation angle of a transmitting beam is made small and it brings close to parallel light, directional control with a strict transmitting beam is needed. The invention in this application offers the approach of performing this strict directional control easily, and enables reduction of the outgoing radiation power required of a sending set. Moreover, in the space optical transmission by the divergence conventional transmitting beam, although the parallel transmission is difficult, at the invention in this application, a transmitting beam may be parallel light and a parallel transmission also becomes possible. On the other hand about the conventional light beam deflecting system, some which are depended on mechanical displacement have the fault that the whole equipment becomes large, and the thing using refractive-index change has the technical problem that a deflecting angle is small. In the invention in this application, the configuration of the light beam deflecting system which a deflecting angle can miniaturize in magnitude comparable as a light emitting device greatly is offered.
[0007]
[Means for Solving the Problem] The sending set containing the direction detector of incidence which judges the direction of incidence of the 1st light emitting device which carries out outgoing radiation of the transmitting beam, the light beam deflecting system which deflects said transmitting beam, and a guide beam with the 1st configuration of the space optical transmission device of this invention, It has a receiving set containing the photo detector which receives the 2nd light emitting device which carries out outgoing radiation of said guide beam, and said transmitting beam, said transmitting beam has an angle of divergence narrower than said guide beam, and said guide beam is modulated by the low-speed signal rather than said transmitting beam. Here, the 1st light emitting device is a surface emission-type laser, the 2nd light emitting device may be a light emitting diode, and light beam deflecting system may consist of an optical element and an actuator. Moreover, what the direction detector of incidence becomes from a lens and a charge-coupled device may consist of the optical element and photo detector which are driven with an actuator.
[0008] The light emitting device carried on the support substrate and said support substrate with the 2nd configuration of the space optical transmission device of this invention, The photo detector which adjoined said light emitting device and was carried on said support substrate, and the lens array which contains in said support substrate the 1st and 2nd lenses by which opposite arrangement was carried out, It has the actuator which drives said lens array, the outgoing radiation beam from said light emitting device passes said 1st lens, and the incident beam to said photo detector passes said 2nd lens.
[0009] the 3rd configuration of the space optical transmission device of this invention -- the part on a

semi-conductor substrate and said semi-conductor substrate -- the part except the surface emission-type laser formed in the field with the lower reflector by which the laminating was carried out one by one, the lower cladding layer, the barrier layer, the up cladding layer, and the up reflector, and said surface emission-type laser on said semi-conductor substrate having been formed -- it has the light emitting diode formed in the field of said lower reflector by which the laminating was carried out one by one, said lower cladding layer, said barrier layer, and said up cladding layer.
[0010] the configuration of the light beam deflecting system of this invention -- the part on the 1 principal plane of a semi-conductor substrate and said semi-conductor substrate -- the support rack which connects the optical element of the suspension condition formed in the boundary region except an opening field in said opening field with the 1st and 2nd thin films by which sequential deposition was carried out, and said 2nd thin film, and said the 2nd thin film and said optical element on said boundary region, and the means to which the variation rate of said support rack is carried out with an electrical signal are included. Here, an optical element may be a reflecting mirror and may be a hologram lens. Moreover, the light emitting device may be formed on the 2nd [of a semi-conductor substrate] principal plane, and said light emitting device may be a surface emission-type laser.
[0011]
[Function] With the 1st configuration of the space optical transmission device of this invention, outgoing radiation of the divergence guide beam is carried out from the receiving set side which receives a signal, and outgoing radiation of the small transmitting beam of an angle of divergence is carried out towards the direction of incidence of this guide beam from a sending set. Since the angle of divergence is small, a transmitting beam can reduce the outgoing radiation power from a sending set, also in case the ratio of the light-receiving power in the receiving set to the outgoing radiation power from a sending set becomes high and performs a high-speed signal transmission. On the other hand, since the guide beam was only used for distinction of the direction of incidence, you could become irregular theoretically. However, in order for background light to prevent becoming a noise and malfunctioning in fact, the modulation which is easy to distinguish by the receiving side is performed. Although a guide beam is divergence, since this modulation is good at a low speed, outgoing radiation power may be small. That is, with this configuration, in addition to the usual transmitting beam, a guide beam is used, but since outgoing radiation power may be small, both sides can reduce the whole power consumption. Moreover, in the space optical transmission by the divergence conventional transmitting beam, although the parallel transmission is difficult, with this configuration, a transmitting beam may be parallel light and a parallel transmission also becomes possible.
[0012] As a more concrete configuration, a surface emission-type laser, then an angle of divergence can be made small for the 1st light emitting device carried in a sending set, and a high-speed modulation is also possible. Let the 2nd light emitting device which carries out outgoing radiation of the guide beam be light emitting diode as well as the conventional space optical transmission device. Moreover, light beam deflecting system which deflects the direction of outgoing radiation of a transmitting beam is realized by carrying out the variation rate of the optical elements, such as a lens and a reflecting mirror, with an actuator. Furthermore, the direction detector of incidence can discriminate whenever [incident angle] from an image formation location by carrying out image formation of the incident beam which passed the lens on a charge-coupled device. Or it is the configuration in which the incident light which passed optical elements, such as a lens driven with an actuator, carries out incidence to a photo detector, and it is also possible to discriminate the direction of incidence from the location of an optical element where the amount of incident light serves as max.
[0013] The 2nd configuration of the space optical transmission device of this invention offers a deviation and the approach of carrying out outgoing radiation in the direction of incidence of a guide beam for a transmitting beam. This configuration not only simplifies the configuration of the sending set in the 1st configuration of the above, but it is applicable to bidirectional space optical transmission devices other than this. This configuration adjoins, carries a light emitting device and a photo detector on a support substrate, and drives with an actuator the lens array which consists of the 1st lens which the outgoing radiation beam from a light emitting device passes, and the 2nd lens which the incident beam

to a photo detector passes. Here, if the 1st lens and 2nd lens are made into the same focal distance and both spacing is made in agreement with spacing of a light emitting device and a photo detector, the outgoing radiation beam from a light emitting device can be deflected in the direction of incidence of an incident beam by adjusting the location of a lens array so that the amount of incident light which carries out incidence to a photo detector may serve as max.

[0014] The 3rd configuration of the space optical transmission device of this invention offers the approach of forming a surface emission-type laser and light emitting diode on the same semi-conductor substrate. In the 1st configuration of the above, if it is going to perform transmission and reception to coincidence, it is necessary to have the light emitting diode which carries out outgoing radiation of the guide beam to the surface emission-type laser to which each transmitter-receiver carries out outgoing radiation of the transmitting beam, and the configuration of **** 3 is useful. here -- the part on said semi-conductor substrate -- although the laminating of a lower reflector, a lower cladding layer, a barrier layer, an up cladding layer, and the up reflector is carried out to a field and considered as a surface emission-type laser, it considers as light emitting diode by removing an up reflector from the same laminated structure. In actual production, crystal growth of a lower reflector, a lower cladding layer, a barrier layer, an up cladding layer, and the up reflector is carried out all over a semi-conductor substrate, and etching removal of the up reflector of the field which forms a light emitting diode is carried out. Field luminescence laser and a light emitting diode can be formed on the same semi-conductor substrate very simple by leaving the part used as a surface emission-type laser and a light emitting diode to the last, and performing mesa etching to it.

[0015] The light beam deflecting system of this invention is formed of the so-called micro mechanics which produces a machine part with the ultra-fine processing technology of a semi-conductor. That is, an actuator is produced on a semi-conductor substrate and a light beam is deflected by carrying out the variation rate of the optical element similarly formed on the semi-conductor substrate. The 1st and 2nd thin films are more specifically deposited in part on the boundary region except an opening field of one principal plane of the semi-conductor substrate which consists of silicon. The 1st thin film consists of silicon oxide, and the 2nd thin film consists for example, of polish recon. On the other hand, there are optical elements, such as a reflecting mirror formed with the 2nd thin film in the opening field or a hologram lens, and it is connected and supported by the support rack by the 2nd thin film on a boundary region. This support rack has the spring function and the optical element of a suspension condition moves idly in an opening field. The variation rate of the support rack can be carried out with an electrical signal, for example, horizontal or a perpendicular direction can be made to carry out the variation rate of the location of an optical element by attracting a support rack with electrostatic attraction here. According to this configuration, light beam deflecting system which a deflecting angle can miniaturize in large and magnitude comparable as a light emitting device is realized. It is also possible to constitute a monolithic light beam deviation light emitting device from forming light emitting devices, such as a surface emission-type laser, on the 2nd principal plane of the semi-conductor substrate with which this light beam deflecting system was formed.

[0016]

[Example]

(Example 1) Drawing 1 is the block diagram of the space optical transmission device of one example of this invention. This space optical transmission device consists of a sending set 101 and a receiving set 102 fundamentally. The sending set 101 contains the 1st light emitting device 103, light beam deflecting system 104, and direction detector 105 of incidence. The 1st light emitting device 103 is a surface emission-type laser, and the light beam deflecting system 104 is constituted by the 1st lens 106 and actuator 107. Moreover, the direction detector 105 of incidence is constituted by a charge-coupled device (CCD) 108 and the 2nd lens 109. The receiving set 102 contains the 2nd light emitting device 110 and photo detector 111. The 2nd light emitting device 110 is a light emitting diode, and carries out outgoing radiation of the divergence guide beam 112. It is condensed and image formation of the guide beam 112 which carried out incidence to the 2nd lens 109 is carried out on a charge-coupled device 108. Since this image formation location corresponds in the direction of incidence of the guide beam 112, the

direction of the receiving set seen from the sending set with the output signal from a charge-coupled device 108 is discriminable. The 1st light emitting device 106 carries out outgoing radiation of the transmitting beam 113 modulated by the sending signal. This transmitting beam 113 is deflected at the same time it is changed into parallel light by the 1st lens 106. This deviation direction is controllable by carrying out the variation rate of the 1st lens 106 with an actuator 107. Therefore, outgoing radiation of the transmitting beam 113 can be carried out towards the direction of a receiving set by controlling an actuator 107 with the output signal from a charge-coupled device 108. This transmitting beam 113 is received by the photo detector 111 of a receiving set 109.

[0017] Since the angle of divergence is small, the transmitting beam 113 of the ratio of the light-receiving power in the photo detector 111 to the outgoing radiation power from the 1st light emitting device 103 is high, and even if the transmitting beam 113 is modulated at high speed, a signal transmission is possible for it by low outgoing radiation power. On the other hand, since the guide beam 112 was only used for distinction of the direction of incidence, you could become irregular theoretically. However, in order for background light to prevent becoming a noise and malfunctioning in fact, the modulation which is easy to distinguish by the receiving side is performed. Although the guide beam 112 is divergence, since it is good at a low speed, it may be small. [of outgoing radiation power] [of this modulation] That is, in this example, in addition to the usual transmitting beam 113, the guide beam 112 is used, but since outgoing radiation power may be small, both sides can reduce the whole power consumption. Moreover, in the space optical transmission by the divergence conventional transmitting beam, although the parallel transmission is difficult, with this configuration, a transmitting beam may be parallel light and a parallel transmission also becomes possible.

[0018] (Example 2) Drawing 2 is the block diagram of the space optical transmission device of the 2nd example of this invention. This example offers a deviation and the approach of carrying out outgoing radiation in the direction of incidence of a guide beam for a transmitting beam. Although this example shows the 2nd configuration of the sending set in the 1st example of the above, it is applicable also to a common bidirectional space optical transmission device. In this example, a light emitting device 201 and a photo detector 202 adjoin, and it is carried on the support substrate 203. The outgoing radiation beam 204 from a light emitting device 201 passes the 1st lens 205. The incident beam 206 to a photo detector 202 passes the 2nd lens 207. It is unified as a lens array 208 and the 1st lens 205 and 2nd lens 207 are driven with an actuator 209. In drawing 2 , although a light emitting device 201 and the 1st two lenses 205 have composition of a certain two-channel parallel transmission at a time, each may be one piece or three pieces or more. The 1st lens 205 and 2nd lens 207 are made into the same focal distance, and if both spacing is made in agreement with main spacing of a lens while arranging a light emitting device 201 and a photo detector 202 in the focal location, the direction of an incident beam 206 and the direction of the outgoing radiation beam 204 from a light emitting device 201 which carry out incidence on a photo detector 202 are in agreement. Therefore, the outgoing radiation beam 204 from a light emitting device 201 can be deflected in the direction of incidence of an incident beam 206 by adjusting the horizontal position of the lens array 208 so that the amount of incident light which carries out incidence to a photo detector 202 may serve as max.

[0019] (Example 3) Drawing 3 is the sectional view of the space optical transmission device of the 3rd example of this invention. This example offers the approach of forming a surface emission-type laser and light emitting diode on the same semi-conductor substrate. In the 1st example of the above, if it is going to perform transmission and reception to coincidence, each transmitter-receiver needs to have the light emitting diode which carries out outgoing radiation of the guide beam to the surface emission-type laser which carries out outgoing radiation of the transmitting beam. Although the example of **** 3 offers the configuration which becomes useful in this case, the application of those other than this is also possible. The laminating of the lower reflector 302, the lower cladding layer 303, a barrier layer 304, the up cladding layer 305, and the up reflector 306 is carried out on semi-conductor substrate top 301 as shown in drawing 3 . The surface emission-type laser 307 consists of these whole laminated structures. Light emitting diode 308 consists of removing the up reflector 306 from the same laminated structure on the other hand.

[0020] The up ring-like electrode 309 is formed in the upper part of a surface emission-type laser 307 and light emitting diode 308, and a current is poured in between the lower electrodes 310. Thereby, from a surface emission-type laser 307, outgoing radiation of the small transmitting beam 311 of an angle of divergence is carried out, and outgoing radiation of the large guide beam 312 of an angle of divergence is carried out from a light emitting diode 308. As the manufacture approach of this example, crystal growth of the lower reflector 302, the lower cladding layer 303, a barrier layer 304, the up cladding layer 305, and the up reflector 306 is carried out all over semi-conductor substrate 301, and etching removal of the up reflector 306 of the field which forms a light emitting diode 308 is carried out. Field luminescence laser and a light emitting diode can be formed on the same semi-conductor substrate very simple by leaving the part used as a surface emission-type laser 307 and a light emitting diode 308 to the last, and performing mesa etching to it.

[0021] (Example 4) Drawing 4 is the important section cross-section perspective view of the light beam deflecting system of the 4th example of this invention. The 1st thin film 404 and 2nd thin film 405 have deposited the part on the boundary region 403 except the opening field 402 of one principal plane of the semi-conductor substrate 401 which consists of silicon. The 1st thin film 404 consists of silicon oxide, and the 2nd thin film 405 consists for example, of polish recon. On the other hand, there is an optical element 406 formed with the 2nd thin film 405 in the opening field, and it is connected and supported by the support rack 407 by the 2nd thin film 405 on a boundary region 403. This support rack 407 has the spring function, and the optical element 406 of a suspension condition moves idly in an opening field. Here, if an electrical potential difference is impressed to an electrode 408, the support rack 407 can be attracted with electrostatic attraction. If electrical-potential-difference impression is performed alternatively, horizontal or a perpendicular direction can be made to carry out the variation rate of the location of an optical element.

[0022] On the other hand, the light emitting device 409 is formed on the 2nd principal plane of the semi-conductor substrate 401. The light emitting device 409 was carried on the thin film substrate 410 which thin-film-ized the compound semiconductor substrate, and has pasted up the thin film substrate 410 on the semi-conductor substrate 401 with the direct cladding technique. The outgoing radiation beam 411 from a light emitting device 409 penetrates the semi-conductor substrate 401, and it carries out incidence to an optical element 406. An optical element 406 is a hologram lens, and it is deflected at the same time it changes the outgoing radiation beam 411 into parallel light. This deviation direction is controllable by carrying out the variation rate of the optical element 406 horizontally. In addition, although this example showed the configuration of the transparency mold which also accumulated the light emitting device 409 by using an optical element 406 as a hologram lens, an optical element is a reflecting mirror and it is also possible to reflect and deflect the outgoing radiation beam from the light emitting device set outside. Moreover, it is also possible to use semi-conductor substrate 401 itself as a compound semiconductor substrate besides direct cladding of a substrate, or to form a light emitting device on a silicon substrate with a dissimilar-material epitaxial growth technique as an approach of accumulating a light emitting device.

[0023]

[Effect of the Invention] Also in case a high-speed signal transmission is performed, it is not necessary to enlarge outgoing radiation power from a sending set, and according to the space optical transmission device of this invention, the power consumption of the whole equipment can be reduced. Moreover, in the space optical transmission by the divergence conventional transmitting beam, although the parallel transmission is difficult, by this invention, a transmitting beam may be parallel light and the parallel transmission of it becomes possible. Furthermore, according to the light beam deflecting system of this invention, the light beam deflecting system which a deflecting angle can miniaturize in magnitude comparable as a light emitting device greatly is realizable.

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] The block diagram of the space optical transmission device of one example of this invention
[Drawing 2] The block diagram of the space optical transmission device of the 2nd example of this invention
[Drawing 3] The sectional view of the space optical transmission device of the 3rd example of this invention
[Drawing 4] The important section cross-section perspective view of the light beam deflecting system of the 4th example of this invention
[Drawing 5] The perspective view of the conventional light beam deflecting system
[Description of Notations]
101 Sending Set
102 Receiving Set
103 1st Light Emitting Device
104 Light Beam Deflecting System
105 The Direction Detector of Incidence
110 2nd Light Emitting Device
111 Photo Detector
112 Guide Beam
113 Transmitting Beam
201 Light Emitting Device
202 Photo Detector
203 Support Substrate
204 Outgoing Radiation Beam
205 1st Lens
206 Incident Beam
207 2nd Lens
208 Lens Array
209 Actuator
301 Semi-conductor Substrate
302 Lower Reflector
303 Lower Cladding Layer
304 Barrier Layer
305 Up Cladding Layer
306 Up Reflector
307 Surface Emission-type Laser
308 Light Emitting Diode
401 Semi-conductor Substrate

402 Opening Field
403 Boundary Region
404 1st Thin Film
405 2nd Thin Film
406 Optical Element
407 Support Rack
501 GaAs Substrate
504 Barrier Layer
509 Diffraction Grating
510 Incident Light Beam
511 Outgoing Radiation Light Beam

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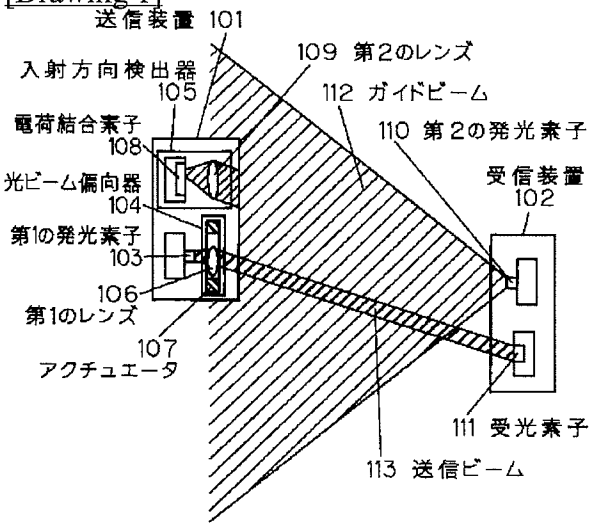
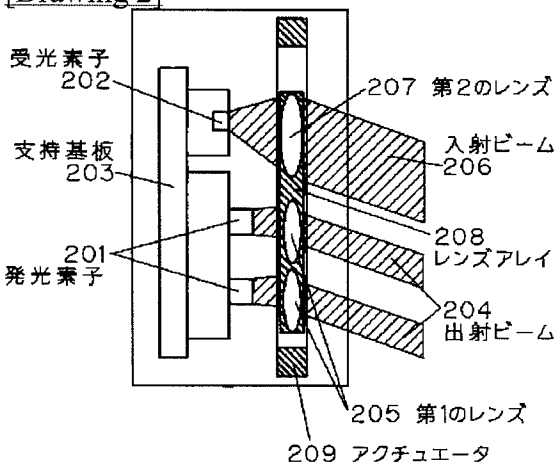
DRAWINGS

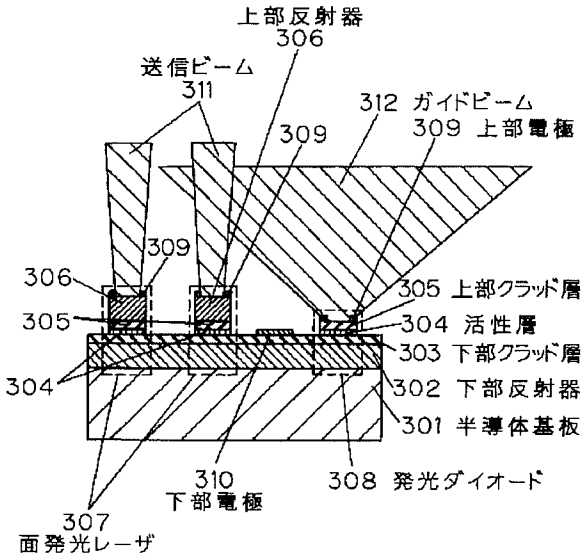
[Drawing 1]



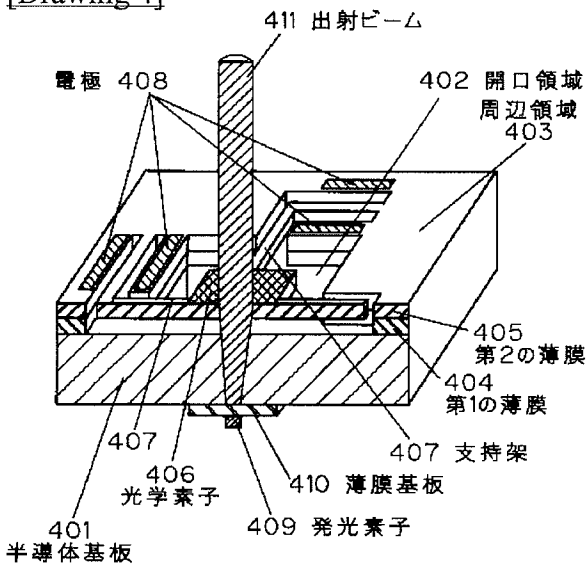
[Drawing 2]



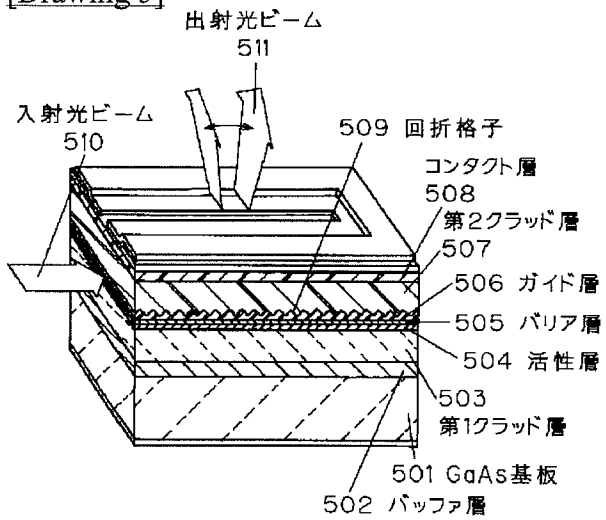
[Drawing 3]



[Drawing 4]



[Drawing 5]



[Translation done.]